MEDICAL RESEARCH DEPARTMENT

U. S. Submarine Base
New London

THE INCLINED PLANE TRAINER

AND

THE STEP TRAINER

AS USED FOR INSTRUCTION IN HULL-DOWN RECOGNITION

AND RANGE ESTIMATION.

First and Final Report

Prepared by

Lieut. William B. Brown, D(L) USNR.

APPROVED: Captain C. W. Shilling, (MC) USN, Medical Officer in Charge.

HULL DOWN RECOGNITION

AND

RANGE ESTIMATION TRAINERS

(1)   THE STEP TRAINER

(2)   THE INCLINED PLANE TRAINER

Work on the development of the In-
clined Plane Trainer, reported herein,
was done at this activity by Lieut.
S. W. Shore and Lieut.(jg) J. G.
Huse. Work on the development of
the Step Trainer was done by Lieut.
Wm. B. Brown and Lieut.(jg) A. S.
Reynolds.

This report is a first and final report.

Medical Research Department
U.S. Submarine Base
New London, Connecticut

5 November 1945

THE HULL-DOWN RECOGNITION AND RANGE ESTIMATION TRAINERS

Summary

Two types of Hull-Down Trainers, to be used in connection with the Ship Recognition Trainer*, have been developed by, and are now in use at the Lookout School, Medical Research Department, U.S.Submarine Base, New London, Connecticut. These are: (1) the Step Trainer, (see Photographs 1, 2, and 3), and (2) the Inclined Plane Trainer, (see photographs 4 and 5).

Sufficient experience in the operation of both devices has now been obtained to give an indication of the results that can be expected from their use. It is felt that either device provides an excellent means of training men in two phases of lookout-recognition work that, chiefly due to the lack of adequate equipment, had previously been ignored or minimized. These two phases of training are (1) instruction in recognition of ships as they would appear over the horizon, or in a hull-down position, and (2) a method, sufficiently easy and sufficiently speedy to be practical, of estimating the range of various types of ships sighted beyond, on, or inside the horizon.

Through the use of either type of hull-down trainer discussed in this report, adequate instruction in both the above phases of lookout-recognition training can be accomplished. Included herein is a brief history of the development of each; a description of construction, with photographs and blueprints, to aid anyone making such equipment; and a description of the instruction techniques developed for their use.

- -

* Previously reported to BuMed by ltr. NB7/A11/S24-2(MR), Serial 3309, dated 3 October 1945, transmitting first interval report on Research Project X-271 (Av-159-c) "The Ship Recognition Trainer".

While the function of both trainers is essentially the same, they differ in construction details, and, to a lesser degree in the methods of instruction employed with each. They will, therefore, be discussed separately in each section of this report.

On the basis of the favorable experience of this activity with both of these hull-down recognition and range-estimation devices, it is thought that other activities concerned with lookout-recognition training might be interested in using similar equipment in their program.

I. BACKGROUND AND HISTORY

The development of an adequate device for the teaching of hull-down recognition came as an obvious step in the development of the ship recognition program as a whole. The need for such equipment was apparent, especially for use in training submarine lookouts. The average height of eye above the water for a submarine lookout is only twenty-five feet. This means that his horizon is a little less than six miles away. It also means that most surface ship targets must be, and will be, picked up and recognized at a greater distance, or while they are hull-down. This same factor will also affect lookouts on other types of ships, although to a lesser degree, the higher their lookout position. In general, however, it can be concluded that hull-down recognition training for all lookouts is most desirable.

It was early noted, however, that it was a practical impossibility to present ships hull-down, as they would appear when beyond the horizon, in anything like a realistic setting with the then-available equipment. Hull-down recognition could be partially achieved by masking slides, and allowing only the desired amount of superstructure to appear. The results were still not realistic.

Models seemed to offer a much more flexible medium with which to work. At the Lookout School it was found that fairly good results could be achieved with models displayed on the Ship Recognition Trainer stage, by placing a small, flat board immediately in front of the ship model, having it just high enough to cut off the desired amount of the ship's hull from the view of the class. Yet with this technique entirely satisfactory results were difficult, due to the awkwardness of handling the various numbers of small boards necessary.

The idea of combining a number of small boards into a graduated step platform suggested itself, and led to the construction of the Step Hull-Down Trainer now in use at the Lookout School. With this device, used in connection with the Ship Recognition Trainer, it is possible to present easily and realistically ships in a broad range of hull-down positions. By the addition of a specially designed platform (see photograph 3) presentation of ships at any desired target angle is possible, while the ship is still in a hull-down position.

The Inclined Plane Trainer (see photographs 4 and 5 and blueprint) was developed about the same time. It presents certain refinements over the Step Trainer, and has certain advantages in instruction. These advantages will be discussed in the section of this report which deals with teaching methods.

II. CONSTRUCTION

1. The Step Trainer

The Step Trainer (see photographs 1, and 2, and 3 for details) is built of layers of wood 1/8" thick. The overall dimensions of the base are 36" long by 10" wide, with seven additional layers built on top, the front edges flush with the front edge of the base and the rear edges stepped down. Each step is 1-1/4" wide. The entire board is painted a drak blue, to match the shade of the Ship Recognition Trainer stage on which it is designed to be used.

Obviously, with each step only 1-1/4" wide, standard U.S.Navy miniature ship models can be presented only in broadside views. To make target angle views possible, however, a special platform device has been designed for use with the Step Trainer. The base of this piece of equipment is 9" by 9". It is built up in four layers, similar to the Step Trainer. In use, the platform is inverted to fit against and into the steps of the Step Trainer at the level desired, thus providing a broad base upon which the model being displayed can be swung through any target angle. It is desirable to mark off a number of lines on the platform to represent headings so that any predetermined target angle can be exactly duplicated later.

2. The Inclined Plane Trainer

The Inclined Plane Trainer is somewhat more complicated; hence a blueprint showing details of construction is included with this report. Paint used is the same shade of dark blue as indicated above, to match the stage of the Ship Recognition Trainer.

III. METHOD OF INSTRUCTION -- RECOGNITION TRAINING

1. The Step Trainer

In use, the Step Trainer is placed on the Ship Recognition stage, with the step side away from the class. Ship models placed on the top step will obviously appear as on the horizon. Moving them to lower steps will expose progressively less of the superstructure. The trainer may be used during each of the three phases of ship recognition training, --the presentation, the review, and the examination.

In presentations, it is suggested that after a ship has been discussed in considerable detail while on the horizon and shown at various target angles and under various illumination intensities, it be placed on the Step Trainer, and its hull-down appearance pointed out to the class. With the 1320:1 or 1200:1 scale models, destroyers should be shown on the second and third steps, with battleships moved as low as the fifth, sixth, or seventh steps.

In reviews, hull-down recognition really comes into its own. This is one of the most effective ways to increase the difficulty and interest of the recognition sessions, and yet to preserve the realism that is so essential. Students readily appreciate the importance of hull-down recognition. With the Step Trainer sessions can be made progressively harder, until a surprising degree of proficiency can be attained in a class. Hull-down recognition, with decreased illumination, is another profitable review technique during later stages of training.

The Step Trainer can be used effectively in examinations. Working from a master test sheet, each model can be presented to different classes on the same step and at the

same target angle. This makes for consistency of examination
material. It is suggested that in examinations destroyers be
placed no lower than the third step, with battleships, in some
exposures, being placed as low as the fifth or sixth steps.
Use can be made of the screening board to take advantage of
the brief exposure.

2. The Inclined Plane Trainer

Much the same use is made of the Inclined Plane
Trainer in hull-down recognition instruction as is made of
the Step Trainer. The former, however, has refinements which
make it preferable in certain aspects of training. This is partic-
ularly true of its use during ship presentations. With this
type of device, the ship can be placed on the horizon, and then,
by manipulating the strings, be made to appear to be going down
over the horizon until it completely disappears from sight. It
can then be brought slowly back to the horizon. This enables the
class to get an excellent idea of the appearance of the ship at
all distances beyond the horizon. The fact that the ship appears
to be in motion is a distinct advantage in promoting interest.

In reviews ships can be placed on the platform while
still below the horizon, and slowly brought up into view. Keen
competition can be developed among students as to who is able
to correctly identify the ship first, as more and more detail
becomes visible. This is an excellent motivating technique
for later stages of training.

The Inclined Plane Trainer is used in examinations
much the same as is the Step Trainer. Marks on the inclined
plane, to be used as settings, make it possible to duplicate
examinations, making sure that no variation is present from
time to time.

In conclusion, each device has certain advantages
in hull-down recognition training. It is difficult to say
which is preferable. Since both are easily and cheaply made,
it is suggested that activities contemplating the use of
this equipment provide themselves with each type.

IV. METHOD OF INSTRUCTION -- RANGE ESTIMATION

Estimation of the range of sighted vessels, using either type of hull-down trainer discussed above, is a lookout skill that receives considerable stress at the Lookout School, at the U.S.Submarine Base, New London, Connecticut. A relatively simple formula, easily grasped by all enlisted personnel, permits sufficiently accurate estimation of ranges of such targets. This formula, (derived from Bowditch) depends upon the earth's curvature, height of eye of the observer above water level, and height of that point at which the horizon cuts across the superstructure of the sighted ship. The range estimation technique works as follows: students are instructed to take the square root of their height of eye in feet (with submarine lookouts the height of eye is approximately 25 feet, and would vary from lookout position to lookout position on other ships), multiplied by the constant 1.15, with the answer giving the distance of the observer from the horizon, in miles. The approximate height at which the horizon cuts the superstructure of the target ship is similarly used as the basis for the computation of the distance of the target ship from the horizon. If the sighted ship is beyond the horizon, the sum of these two distances will give the total distance of target in miles. When the sighted ship is inside the horizon, however, the results must obviously be substracted, not added.

To help students in range estimation sessions, a brief table of average superstructure heights of the principal types of U.S. combat ships has been prepared. This is memorized by the students during the first session, and is used in later drills. This table is reproduced here:

	Mast	Tower	Stack	Bridge	Fli.deck	Bow	Stern
BB	156	133	100	64		36	25
CR	121	Director	81	64		30	25
DD	90	56	49	43		21	9
Large Carriers	156		133	110	64	42	25
Small Carriers	100		64	73	49	36	21

Drills in range estimation are conducted much as are recognition review periods, with models being exposed serially to the class in varying hull-down positions and at various target angles. Students write down the estimated range, with the instructor giving the correct range after each exposure. All types of ships, --BB's, CV's, CA's, CL's, and DD's, are shown during the drill.

Both the Step Trainer and the Inclined Plane Trainer are claibrated to facilitate instruction. Reference to the range scale on each trainer gives the instructor an easy check on the exact range. Calibrations are based on the use of the 1200:1 scale models, read to the closest half-mile, and are given on the basis of the range of the target ship from its horizon. This last factor necessitates taking into account the height of eye of the observer in the final calculation. In practice, students are given different heights f eye, and are thus trained to estimate range from any lookout position.

With the Step Trainer calibration marks are written on each step. A 1200:1 scale model on the first step below the horizon would be 3-1/2 miles from the horizon; second step = 6 miles; third = 7 miles; fourth = 8 miles; fifth = 9 miles; sixth = 10 miles; seventh = 11 miles; and eighth= 11.5 miles.

The Inclined Plane Trainer is calibrated by a series of marks along the far edge of the incline, gauged to show the ship's distance from its horizon in miles. The correct reading is obtained by lining the upper edge of the display platform up on the desired range mark. This calibration can easily be marked off by using the scale of one inch below the horizon equaling 100 feet of superstructure height on a sighted vessel. Thus, when the top of the display paltform is one inch below the horizon, a ship model (1200:1 scale) hull-down would appear to be 11.5 miles from the horizon.

V. CONCLUSION

Experience at this activity with both types of hull-down trainers, using them in hull-down recognition training and in range estimation, has been entirely satisfactory. They have become an integral part of the lookout-recognition training program.